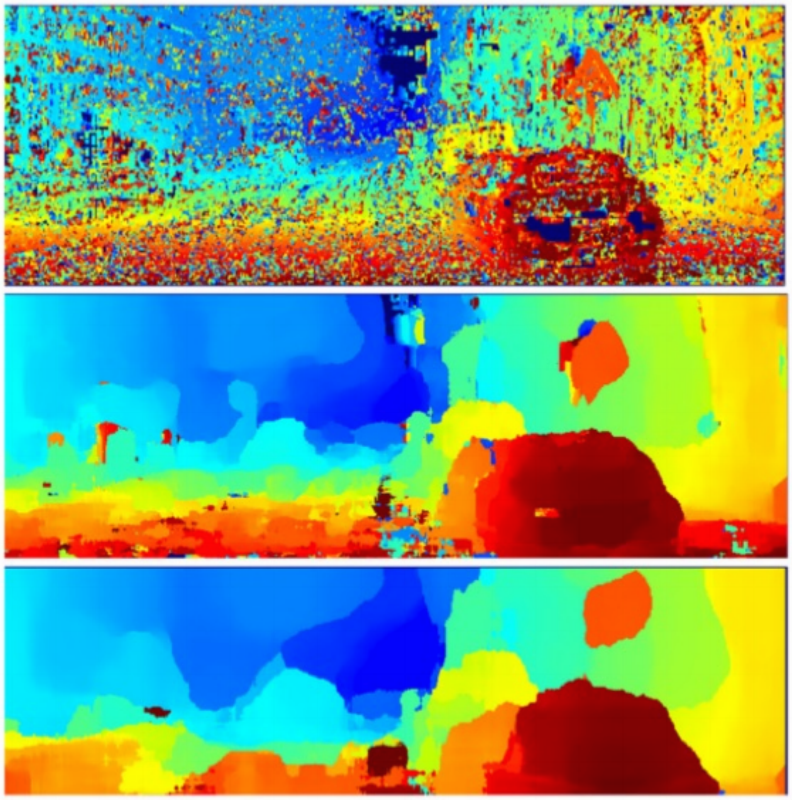
LECTURE 7 : DEPTH FROM RECTIFIED IMAGES

[0] Disparity Map from Rectified Images:

Pixel or patch based operations :



patch size = 5

patch size = 35

patch size = 85

Problem : small patches → more details but more noise
large patch → less noise but less details

Solution : MRF

$$D^* = \underset{\{D\}}{\operatorname{argmin}} \sum_{x} \left(f_d(\bar{x}, D(\bar{x}), \underline{I, I'}) + \lambda \sum_{y \in N_x} f_p(D(\bar{x}), D(\bar{y})) \right)$$

disparity map

pixel location

input images

disparity to estimate

$\{D\} = \{d_{min} \ldots d_{max}\}$

the range of disparity values

Data term:

$$\boxed{f_d(\bar{x}, D(\bar{x}), I, I') = \underbrace{\left[I(\bar{x}) - I'(\bar{x} + D(\bar{x})) \right]^2}_{\text{Photo-consistency constraint}}}$$

If $\{d_{min} \dots d_{max}\}$ has 10 values: $d_1, d_2, \dots d_{10}$; then pixel $\bar{x}$ has 10 possible values of f_d, where each of them is the data cost of d_i.

Prior term:

$$\boxed{f_p(D(\bar{x}), D(\bar{y})) = \underbrace{\left(D(\bar{x}) - D(\bar{y}) \right)^2}_{\text{smoothness constraint}}}$$

If we have 10 values of $\{d_{min} \dots d_{max}\}$ for each pixel, we will have 100 values of f_p:

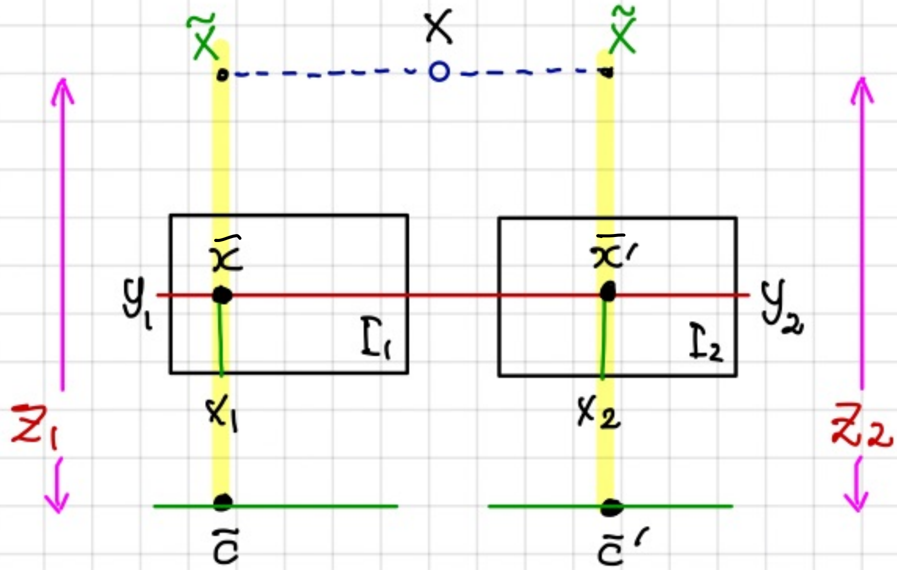
$$\begin{array}{cc|cccc}
 & & & D(x) & & \\
 & & d_1 & d_2 & \dots & d_{10} \\
\hline
 & d_1 & (d_1-d_1)^2 & (d_2-d_1)^2 & & (d_{10}-d_1)^2 \\
D(y) & d_2 & \vdots & \vdots & & \vdots \\
 & \vdots & & & & \\
 & d_{10} & & & &
\end{array}$$

These values are applied to all pixels, exactly in the same way.

$\Downarrow$

Having set the data and prior term for every pixel of the left image, we optimize the graph using graphcuts.

For a pair of rectified images, there is only one disparity or depth map:



Though, before being rectified, there are 2 depth maps: